

PCT

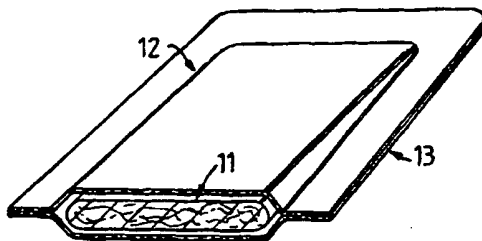
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(21) International Application Number: PCT/SE94/00477 (22) International Filing Date: 20 May 1994 (20.05.94) (30) Priority Data: 9301972-7 9 June 1993 (09.06.93) SE (71) Applicant (for all designated States except US): MÖLNLYCKE AB [SE/SE]; S-405 03 Göteborg (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): QUIST, Magnus [SE/SE]; Hästhagsvägen 6, S-448 36 Floda (SE). (74) Agent: BJERNDELL, P.; H. Albihs Patentbyrå AB, P.O. Box 3137, S-103 62 Stockholm (SE).	(81) Designated States: AU, CA, CZ, FI, HU, JP, NO, NZ, PL, SK, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.	

(54) Title: AN ABSORBENT STRUCTURE AND AN ABSORBENT ARTICLE WHICH INCLUDES THE ABSORBENT STRUCTURE



(57) Abstract

An absorbent structure in an absorbent article, such as a sanitary napkin, tampon, panty protector, incontinence guard, diaper and the like, which is produced by including in the absorbent structure a polymeric foam having cells which were initially essentially closed and which has been worked so as to open said cells, and the structure has obtained liquid take up properties. The foam has a density between 0.01-0.5 g/cm³. The material has properties which are effective in achieving the function for which the product is intended. The foam may be formed as a sheet and the sheet can be made very thin and light, with a surface weight of between 10-500 g/m², and the article will therefore exhibit good comfort properties to the wearer and requires only a small amount of material for its manufacture.

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An Absorbent Structure and an Absorbent Article Which Includes the Absorbent Structure

The present invention relates to an absorbent structure in an absorbent article, such as a sanitary napkin, tampon, panty protector, incontinence guard, diaper and the like.

5 Many different types of absorbent articles of this kind are known to the art. The absorbent body of such products is conventionally produced by dry-defibering cellulose pulp in roll, bale or sheet form for instance, and converting the cellulose pulp in fluffed form to a pulp mat, sometimes admixed with so-
10 called superabsorbents in the pulp mat, these superabsorbents being polymers which are capable of absorbing many times their own weight of water or body fluid.

The pulp body is often compressed, with the intention of enhancing its fluid-dispersion properties and also to lower the bulk
15 of the pulp body and therewith to obtain a product which is as compact as possible.

The absorbent body may include other constituents, for instance
20 to improve the fluid-receiving properties or the liquid-dispersion properties of the absorbent body, or to increase its coherency and its ability to resist deformation in use.

With the majority of sanitary products, it is desired that the
25 article shall be thin and pliable, partly to enable the article to be worn as discretely as possible and partly so that the article will feel as comfortable as possible to the wearer. Another problem is the so-called rewetting problem. By rewetting is meant that body fluid that has already been absorbed by the
30 sanitary article is pressed back into contact with the wearer's skin by external forces, for instance when the wearer sits down. It is a general desire that the surface of the article which lies proximal to the user will remain as dry as possible.

35 With regard to absorbent articles, it is desired to reduce the amount of material in the article, so as to reduce commensurate-

ly the amount of waste that occurs when the used product is thrown away. It is also desired to enable the article to be manufactured from biologically degradable material.

5 Other problems concerning absorbent articles reside partly in their total absorption capacity, and also in that the articles often leak long before their total absorption capacity has been utilized to the full. Among other things, this is because the discharged body fluid is unable to penetrate into the absorbent
10 material and be dispersed to hitherto unused regions of the article quickly enough, but instead leaks from the sides of the sanitary napkin, diaper or incontinence guard. The ability of the materials used in such articles to disperse the absorbed fluid through-out the whole of the absorbent body is thus an im-
15 portant feature of such articles.

A very large part of the production plant employed in the manufacture of such sanitary articles is normally comprised of defibrating equipment, pneumatic conveyor systems and mat-forming equipment. This equipment often constitutes serious source
20 of error and faults in the production plants. Additionally, this equipment is often followed by equipment for compressing the finished pulp mat or the finished sanitary article.

25 EP 0,044,624 and US-A-4,394,930, among others, describe polymeric foam having superabsorbent properties for use in absorbent articles. The use in absorbent articles of polymeric foam which lacks superabsorbent properties is described in EP 0,163,150 and EP 0,299,122, among others. Although these absorbent articles
30 obtain good properties, the manufacturing process is relatively complicated and the materials thus produced are relatively expensive.

US-A-3,834,389 describes how a polyurethane foam, for instance,
35 can be chemically reticulated in order to open up the common walls between adjacent cell, which enhances the absorbancy of the foam.

The object of the present invention is to provide an absorbent structure in an absorbent article of the kind defined in the introduction which will afford a high degree of comfort to the wearer, among other things with regard to thinness and suppleness. It is also desired to reduce the amount of material consumed in manufacture. The article will preferably have good absorbent properties and low rewetting tendencies. It is also desired that an absorbent article of the kind defined in the introduction can be manufactured in a simplified manner. These desiderata are satisfied by means of the present invention, in that the absorbent structure includes a foamed polymeric material having a density of 0.01-0.5 g/cm³ and cells which are initially essentially closed but which have been opened to increase the fluid take up properties, e.g. the sorbing properties, of the material.

The invention will now be described in more detail with reference to exemplifying embodiments thereof and also with reference to the accompanying drawings, in which

Figure 1 illustrates how the instantaneous absorption of the material is influenced by the number of times the material has been perforated by needling;

Figure 2 shows how instantaneous-rewetting and rewetting of the material is influenced by the number of times that it has been perforated by needling;

Figure 3 shows how the instantaneous absorption of the material is influenced by its thickness, and also shows a comparison with a reference product;

Figure 4 shows how instantaneous-rewetting and rewetting of the material is influenced by its thickness, and also shows a comparison with a reference product;

Figure 5 shows how instantaneous-rewetting and rewetting of the material is influenced by the surfactant concentration of the solution used to surface-modify the material;

Figure 6 illustrates a comparison between instantaneous-rewetting and rewetting of an inventive material and various reference products;

- 5 Figure 7 illustrates a comparison between instantaneous-rewetting and rewetting of an inventive material with and without SAP-tissue and a reference product;

Figure 8 is a top view of one example of an inventive absorbent
10 article; the section A-A is shown in Figures 9 and 10;

Figure 9 is a cross-sectional view of an example of the schematic construction of an absorbent article constructed in accordance with one embodiment of the invention; and
15

- Figure 10 is a cross-sectional view of an example of the schematic construction of an absorbent article according to one embodiment of the invention in combination with SAP-tissue.
- 20 As before mentioned, comfort properties, such as softness and suppleness, and absorption properties such as absorption capacity, absorption rate and rewetting, are all important properties of a material used in the manufacture of a sanitary article. The fluids concerned include urine, menstruation blood, blood and
25 wound fluids.

The object of the present invention is to provide an absorbent structure in an absorbent article, such as a sanitary napkin, tampon, panty protector, incontinence guard, diaper and the
30 like, which will afford a high degree of comfort to the wearer, with regard to thinness and suppleness among other things. Another object is to reduce the amount of material consumed in manufacture. The material used in the article will also preferably have good absorption properties and exhibit low rewetting
35 tendencies. A further object is to simplify the process of manufacture. A ready-to-use absorbent material in roll form which can be used without needing to defiber the material will eliminate the requirement of the aforesaid defibering equipment, pneumatic conveyor system and mat-forming equipment.

The aforesaid objects have been solved in accordance with the invention, by including in the absorbent structure a sheet which comprises a foamed polymeric material having cells which were initially essentially closed and which have been opened so as to increase the fluid take up properties of the material. The foam has a density of 0.01-0.5 g/cm³.

By perforating the foamed polymeric material by means of a needling process, the material is given absorption properties which render said material highly suited for use as an absorbent material in the majority of sanitary articles. Perforation of the material opens the cells in the polymeric material which were initially closed, so as to form open structures having fluid take up properties.

The material can be perforated mechanically by needling in the manner used to produce needled felt for instance, or with the aid of water jets under high pressure in the manner used to obtain spunlace nonwoven material.

The aforesaid methods of working the material shall be seen solely as examples, and it will be understood that other methods can be applied to achieve corresponding results. An example of other conceivable methods is one in which the material is perforated by electromagnetic radiation or with the aid of laser radiation.

The aforesaid polymeric foam has been found to provide a highly efficient absorbent material and it has also been found possible to use this absorbent material in sanitary articles. The foamed sheet can be made very thin, therewith obviating the need to further compress the product. However, the sheet will permit further compression, if this is desirable in respect of some product application. A suitable sheet surface weight is 10-500 g/m².

The polymeric foam can be produced from both thermoplastic and thermosetting resins. The thermoplastics that can be used include simple polyolefins, for instance polyethylene, which is an

inexpensive and commercially abundant material. The thermosetting materials that can be used include polyurethanes.

5 Foamed material can be produced from these plastics, for instance by blowing air into the molten plastic bath during manufacture, or by foaming the material through fermentation by gas formation resulting from chemical reactions in the polymeric material.

10 When polyolefins are used to apply the invention, the absorbent article can be made very light in weight, and therewith economically beneficial. It is possible to reduce the weight of the absorbent body to 5-10% of the weight of a corresponding absorbent body made of conventional cellulose material, while retaining the requisite absorption capacity of said body.

20 The amount of waste represented by the absorbent article can also be reduced, by using bioplastics, which are renewable and biologically degradable. Examples of such materials are polysaccharide, polylactides and polyhydroxy alkanoids, and mixtures of such polymers. Other types of degradable polymers can also be used.

25 When polyolefins are used to apply the invention, it is necessary to modify the original hydrophobic surface to a hydrophilic surface. This surface modification can be achieved in different ways, for instance by adding surfactants, by plasma treatment, by corona treatment, by copolymerization, by admixing other polymers, or by other methods. When a surfactant is added to a material according to the invention, its properties can be adjusted with regard to absorption rate, absorption capacity, rewetting tendencies, etc.

35 A material according to the invention can be combined with conventional absorbent materials, for instance cellulose pulp, or with superabsorbent material, to form an absorbent structure. An example of one such material is a so-called SAP-tissue which is comprised of two layers of cellulose wadding with an intermediate layer of superabsorbent. A suitable surface weight with

regard to SAP-tissue is 50-100 g/m², divided over two layers of cellulose wadding with a surface weight of 10-20 g/m² and a layer of superabsorbent having a surface weight of 40-80 g/m². Such an absorbent structure obtains an improved instantaneous absorption and better rewetting properties than an absorbent structure having solely a polymeric foam according to the invention.

Investigation of Material Properties

10 The following test methods and test equipment were applied to evaluate the properties of the material.

Method 1 - Determining Instantaneous Absorption

A sample body measuring 65 x 200 mm was punched from the material, weighed and then placed onto a flat supporting surface. 15 ml of sample liquid (0.9% NaCl-solution) was applied to the wetting point of the sample body. The time taken to absorb all liquid was measured in seconds. This time period was expressed as instantaneous absorption.

20

Method 2 - Determining Instantaneous Rewetting

A sample body measuring 65 x 200 mm was punched from the material, weighed and then placed on a flat supporting surface. 15 ml of sample liquid (0.9% NaCl-solution) were applied to the wetting point of the sample body. A filter paper was then placed on top of the wetting point and subjected to a load of 5 kPa for 15 seconds. The filter paper was weighed before and after applying the load and the difference calculated. The result, expressed in grams, was expressed as instantaneous-rewetting.

30

Method 3 - Determining Rewetting

This method was applied to determine rewetting after a load had been applied over a given time period. A sample body measuring 65 x 200 mm was punched from the material, weighed and then placed on a flat supporting surface. 15 ml of sample liquid (0.9% NaCl-solution) were applied to the wetting point of the sample body. A plexiglass plate having a larger surface than the sample body was then placed on top of the body and subjected to a load of 5 kPa for 5 minutes. The plexiglass plate was then

removed and a filter paper was placed on the wetting point and subjected to a load of 5 kPa for 15 seconds. The filter paper was weighed before and after subjecting the body to load and the result, expressed in grams, was expressed as rewetting.

5

Method 4 - Manufacture of Sample Bodies for Determining the Surfactant Influence

A sample body measuring 65 x 200 mm was punched from the material, weighed and then placed in a container containing an aqueous
10 surfactant solution for 5 minutes. The sample body was then removed from the container and allowed to drain for 5 minutes, whereafter the sample body was subjected to a load of 10 kPa for 5 minutes. The sample body was then dried in the absence of load at a temperature of 40-60°C for 10-15 hours. The sample body was
15 then tested according to one of the Methods 1-3.

The Influence of the Needling Degree

Instantaneous absorption of a surfactant-treated polyethylene foam according to the invention, having a thickness of 4 mm, a
20 surface weight of 80 g/m², and a density of 0.02 g/cm³, and which had been needled a different number of times was determined. The results were determined in accordance with Method 1.

- A Inventive material, needled twice.
- B Inventive material, needled three times.
- 25 C Inventive material, needled four times.

It will be seen from Figure 1 that material which had been needled three times had a slightly quicker instantaneous absorption than the remaining materials.

30 Instantaneous-rewetting and rewetting of a surfactant-treated polyethylene foam according to the invention having a thickness of 4 mm, a surface weight of 40 g/m² and a density of 0.02 g/cm³, and which had been needled a different number of times was determined. The results were determined according to Method 2 and

35 Method 3.

- A Inventive material, needled twice.
- B Inventive material, needled three times.
- C Inventive material, needled four times.

It will be seen from Figure 2 that instantaneous-rewetting and rewetting increases slightly when the number of needlings are increased.

5 Influence of Material Thickness on Instantaneous Absorption

Instantaneous absorption of a surfactant-treated polyethylene foam according to the invention, having a density of 0.02 g/cm^3 , and which had been needled three times, was determined. The
10 reference product comprised a conventional cellulose pulp mat. The results are shown in Figure 3. The results were determined according to Method 1.

- A Pulp mat thickness 4 mm, density 0.12 g/cm^3 .
- B Inventive material, thickness 2 mm.
- 15 C Inventive material, thickness 3 mm.
- D Inventive material, thickness 4 mm.

It will be seen from Figure 3 that material constructed in accordance with the invention has quicker instantaneous absorption when the thickness of the material increases.

20

Influence of Material Thickness on Instantaneous-Rewetting and Rewetting

Instantaneous-rewetting and rewetting of surfactant-treated polyethylene foams according to the invention having different
25 thickness, 2-4 mm, and a density of 0.02 g/cm^3 , and which had been needled three times, was determined. The reference product comprised a conventional cellulose pulp mat. The results are shown in Figure 4. The results were determined according to Method 2 and Method 3.

- 30 A Pulp mat thickness 4 mm, density 0.12 g/cm^3 .
- B Inventive material, thickness 2 mm.
- C Inventive material, thickness 3 mm.
- D Inventive material, thickness 4 mm.

It will be seen from Figure 4 that instantaneous-rewetting of
35 inventive material increases slightly when the material thickness increases within the range of 2-4 mm. Rewetting is lower than rewetting of the reference product, in all cases. It will also be seen that rewetting of material constructed in accordance with the invention decreases when the material thickness

increases within the range 2-4 mm. Rewetting is comparable with or lower than with the reference product, in all cases.

Surfactant Admixture and Its Influence on Rewetting

- 5 Instantaneous-rewetting and rewetting of a surfactant-treated polyethylene foam according to the invention, having a density of 0.02 g/cm^3 , and a thickness of 4 mm, and which had been needled three times and treated with surfactant solutions of various concentrations is shown in Figure 5. The samples were
10 manufactured in accordance with Method 4, and the results were determined according to Method 2 and Method 3.

- A Inventive material, 0.1% surfactant solution.
- B Inventive material, 0.25% surfactant solution.
- C Inventive material, 1% surfactant solution.
- 15 D Inventive material, 5% surfactant solution.

It will be seen from Figure 5 that instantaneous-rewetting and rewetting decreases when the surfactant concentration increases within the range given.

20 Rewetting Compared with Conventional Products

- Instantaneous-rewetting and rewetting for a surfactant-treated polyethylene foam according to the invention, having a density of 0.02 g/cm^3 , a thickness of 4 mm, and which had been needled three times, and also for conventional pulp pads were determined
25 according to Method 2 and Method 3. The conventional products comprised different cellulose-fibre pulp mats. The results are shown in Figure 6.

- A Pulp mat thickness 10 mm, density 0.08 g/cm^3 .
- B Pulp mat thickness 4 mm, density 0.2 g/cm^3 .
- 30 C Material constructed in accordance with the invention.

It will be seen from Figure 6 that the instantaneous-rewetting and rewetting values of the inventive material are comparable with or lower than with the reference products. Reference 2 has
35 the best instantaneous-rewetting value; while an inventive material has the best rewetting value.

Rewetting of an Absorbent Body Incorporating SAP-Tissue, as Compared with Conventional Products

Instantaneous-rewetting and rewetting of a surfactant-treated polyethylene foam according to the invention, having a density of 0.02 g/cm^3 , a thickness of 4 mm, and which had been needed three times and tested with and without the inclusion of SAP-tissue and of a conventional pulp pad were determined according to Method 2 and Method 3. The SAP-tissue was comprised of two layers of 15 g/m^2 cellulose wadding and an intermediate 40 g/m^2 layer of superabsorbent. The conventional product comprised a pulp mat of cellulose fibres. The results are shown in Figure 7.

10 A Pulp mat thickness 10 mm, density 0.08 g/cm^3 .
 B Inventive material, 4 mm without SAP-tissue.
 C Inventive material, 4 mm + 70 g/m^2 SAP-tissue.

It will be seen from Figure 7 that inventive material which included SAP-tissue exhibited better instantaneous rewetting values and rewetting values than the reference product.

15

Density and Surface Weight

The material can be made very thin, down to a thickness of about 1 mm, and consequently it is unnecessary, in many cases, to further compress the material prior to its use in an absorbent article. A suitable density is $0.01\text{--}0.5 \text{ g/cm}^3$, preferably $0.01\text{--}0.2 \text{ g/cm}^3$, and more preferably $0.02\text{--}0.1 \text{ g/cm}^3$. A suitable surface weight is $10\text{--}500 \text{ g/m}^2$, preferably $20\text{--}200 \text{ g/m}^2$ and more preferably $40\text{--}100 \text{ g/m}^2$.

20

25

Description of an Exemplifying Embodiment

Figure 9 is a cross-sectional view of an inventive sanitary napkin according to a first embodiment. The napkin includes, conventionally, an absorbent body 11 which is enclosed between a liquid-permeable top sheet 12, which is suitably comprised of perforated plastic film, nonwoven material or like material, and which lies proximal to the wearer in use, and a liquid-imperious bottom sheet 13. The sheets 12 and 13 have parts which extend beyond the absorbent body 11, and are mutually joined at these parts. The bottom sheet 13 is comprised of a suitable plastic material, for instance polyethylene. Naturally, the top sheet and the bottom sheet may be formed from other known materials, within the scope of the invention.

30

35

The absorbent body 11 consists solely of one single layer. This layer may be comprised of inventive material and optionally 0-10% superabsorbent material. A suitable density range with regard to the absorbent body 11 is $0.01-0.1 \text{ g/cm}^3$, while a
5 suitable surface weight is $20-100 \text{ g/m}^2$.

Figure 10 is a cross-sectional view of a sanitary napkin according to a second embodiment of the invention, this embodiment differing from the embodiment illustrated in Figure 9, in that
10 the absorbent body 21 includes two layers 24 and 25. The layer 24 may be comprised of material according to the invention, and optionally also 0-10% superabsorbent material. The layer 25 may be comprised of so-called SAP-tissue, which consists of two layers of cellulose wadding, about 15 g/m^2 , and a layer of
15 superabsorbent material, about 40 g/m^2 , placed between said two layers of cellulose wadding. A suitable density range with regard to the layer 24 is $0.01-0.1 \text{ g/cm}^3$, while a suitable surface weight is $20-100 \text{ g/m}^2$.

20 It will be understood that the invention is not restricted to the described and illustrated exemplifying embodiments thereof and that other embodiments are conceivable within the scope of the concept of the invention.

Claims

1. An absorbent structure in an absorbent article, such as a diaper, sanitary napkin, tampon, panty protector, incontinence guard or the like, **characterized** in that the absorbent structure includes a foamed polymeric material having a density of 0.01-0.5 g/cm³ and cells which were initially essentially closed and which have been opened to increase the fluid take up properties of the material.
2. An absorbent structure according to Claim 1, **characterized** in that the cells have been opened by mechanical treatment.
3. An absorbent structure according to Claim 2, **characterized** in that said treatment has been effected by perforating the polymeric material by needling.
4. An absorbent structure according to Claim 2, **characterized** in that the treatment has been effected by perforating the polymeric material with the aid of water jets.
5. An absorbent structure according to Claim 1, **characterized** in that the cells have been opened by treating the polymeric material with electromagnetic radiation.
6. An absorbent structure according to Claim 1, **characterized** in that the cells have been opened by treating the polymeric material with laser.
7. An absorbent structure according to one or more of the preceding Claims, **characterized** in that the density is 0.01-0.2 g/cm³, preferably 0.02-0.1 g/cm³.
8. An absorbent structure according to one or more of the preceding Claims, **characterized** in that said structure has the form of a sheet having a surface weight of 10-500 g/m², preferably 20-100 g/m² and more preferably 40-80 g/m².

9. An absorbent structure according to one or more of the preceding Claims, characterized in that the polymeric material principally consists of one or more polyolefins.
- 5 10. An absorbent structure according to one or more of the preceding Claims, characterized in that the polymeric material includes 0.1-25 percent by weight of surfactant.
- 10 11. An absorbent structure according to one or more of the preceding Claims, characterized in that the polymeric material includes 1-50 percent by weight of superabsorbent material.
- 15 12. An absorbent structure according to one or more of the preceding Claims, characterized in that the structure includes a separate layer of some other absorbent material.
13. An absorbent structure according to Claim 12, characterized in that the separate layer of absorbent material includes cellulose fibres and superabsorbent material.
- 20 14. An absorbent article, such as a diaper, sanitary napkin, panty protector, incontinence guard and the like, comprising a liquid-permeable top sheet, an essentially liquid-impervious bottom sheet and an absorbent body enclosed between said sheets,
- 25 characterized in that the absorbent body includes an absorbent structure according to one or more of Claims 1-13.

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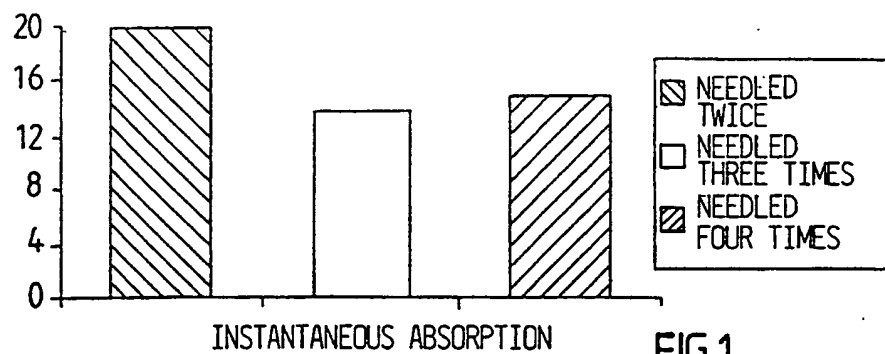
INSTANTANEOUS
ABSORPTION (s)

FIG.1

REWETTING (g)

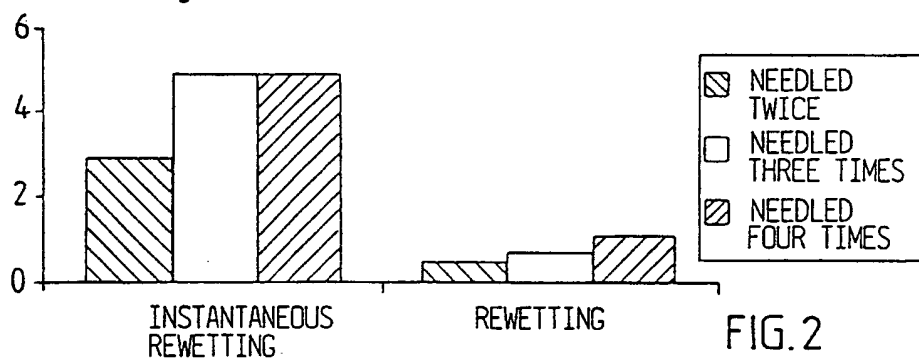


FIG.2

- INSTANTANEOUS ABSORPTION (s)

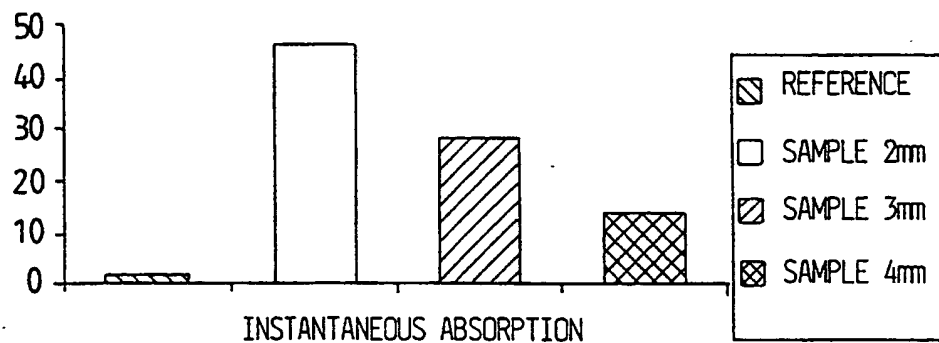
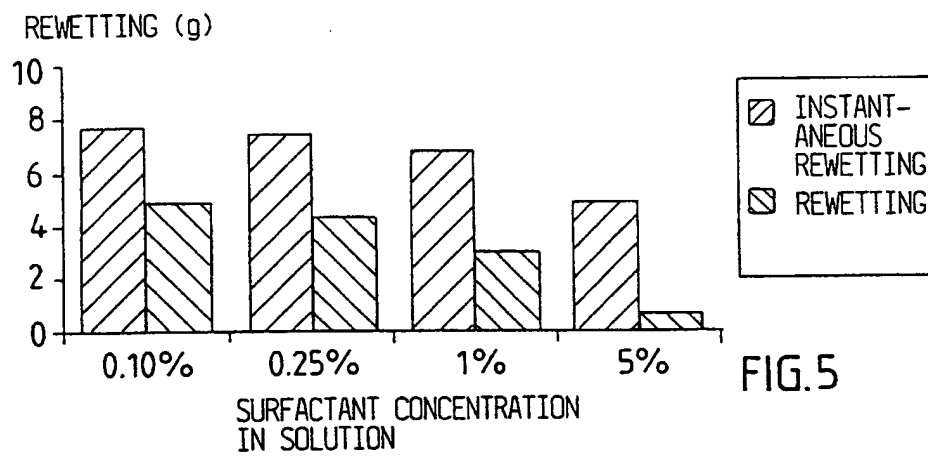
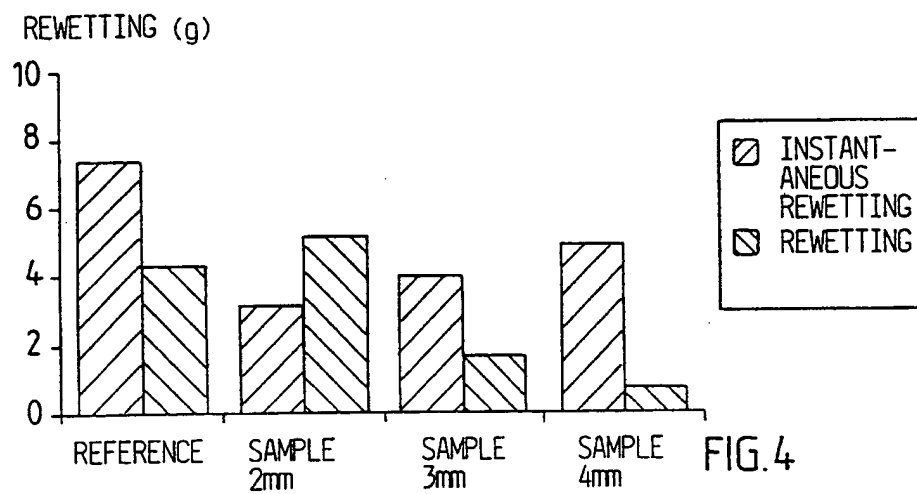
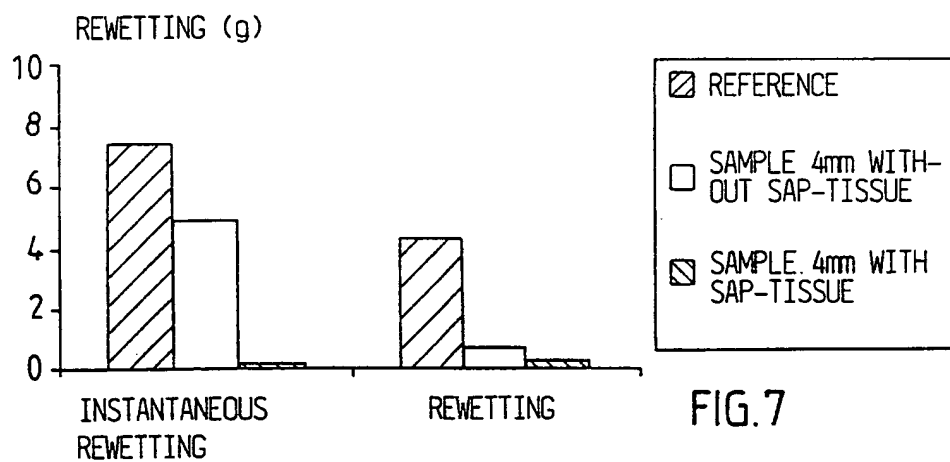
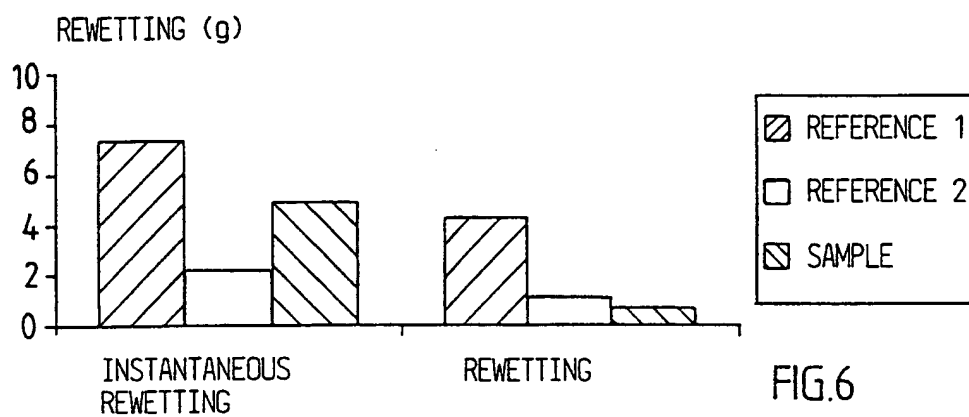


FIG.3

2/4



3/4



4/4

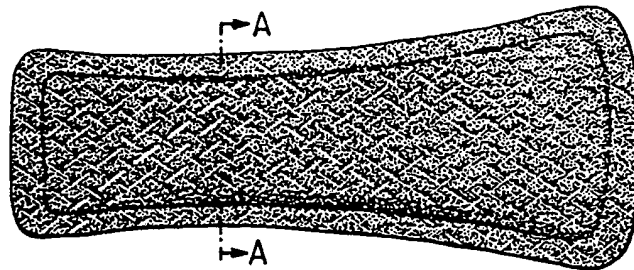


FIG. 8

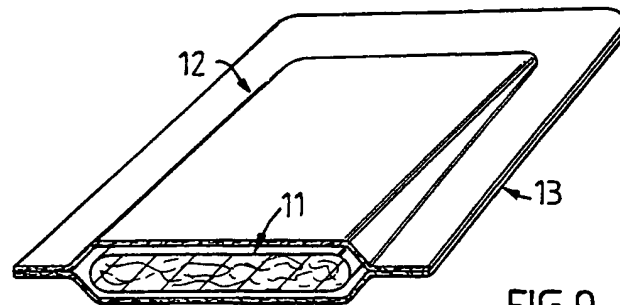


FIG. 9

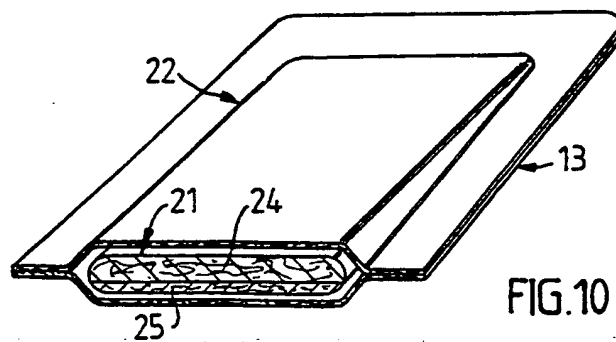


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 94/00477

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A61F 13/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DERWENT WORLD PATENT INDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3834389 (BERNARD ALLEN DULLE), 10 Sept 1974 (10.09.74), column 6, line 36 - line 43 --	1-14
Y	US, A, 4423101 (DONALD A. WILLSTEAD), 27 December 1983 (27.12.83), see claims 1-5 --	1-14
Y	US, A, 3371667 (E.A. MORSE), 5 March 1968 (05.03.68), column 5, line 46 - line 48; column 5, line 59 - line 62 --	1-14

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT
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